

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY09 Final Performance Report
July 15, 2010**

Cover Page

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| Fiscal Year: | 2009 |
| USDA-ARS Agreement ID: | NA |
| USDA-ARS Agreement Title: | Single Kernel Sorting Technology for Enhancing Scab Resistance and Grain Quality. |
| FY09- USDA-ARS Award Amount: | \$ 24,440 |

USWBSI Individual Project(s)

| USWBSI Research Category* | Project Title | ARS Adjusted Award Amount |
|----------------------------------|---|----------------------------------|
| HW-CP | Single Kernel Sorting Technology for Enhancing Scab Resistance and Grain Quality. | \$ 24,440 |
| | Total Award Amount | \$ 24,440 |

Floyd Dowell
Principal Investigator

6/14/10
Date

* MGMT – FHB Management
 FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
 GDER – Gene Discovery & Engineering Resistance
 PBG – Pathogen Biology & Genetics
 BAR-CP – Barley Coordinated Project
 DUR-CP – Durum Coordinated Project
 HW-CP – Hard Winter Wheat Coordinated Project
 VDHR – Variety Development & Uniform Nurseries – Sub categories are below:
 SPR – Spring Wheat Region
 NWW – Northern Winter Wheat Region
 SWW – Southern Sinter Wheat Region

Project 1: *Single Kernel Sorting Technology for Enhancing Scab Resistance and Grain Quality.***1. What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

Development of Fusarium resistant/tolerant wheat varieties requires the screening of kernel samples from a large number of germplasm/crosses for *Fusarium* damage and deoxynivalenol (DON) levels. At present visual methods are mostly used for evaluation of *Fusarium* damaged kernels (FDK) while gas chromatography- mass spectrometry or ELISA based methods are used for determination of DON levels. Visual FDK analysis is subjective and laborious while chemical DON determination methods are destructive and expensive. We have developed near infrared based single kernel techniques using our Single Kernel Near Infrared (SKNIR) system for rapid, nondestructive and objective evaluation of FDK and DON levels in small grain samples for screening FHB resistance. The accuracy of these techniques has been validated using grain samples with predetermined levels of FDKs from the UNL.

Studies conducted also showed that SKNIR technique can be used to estimate bulk DON levels in small kernel samples based on single kernel analysis. In addition to the bulk sample DON level, it is also possible to see how the final bulk DON level of the sample is composed of, which is very valuable information that is impossible with GC-MS or ELISA based methods, unless such methods are used for analysis of each single kernel that is obviously very uneconomical and almost impractical when large number of bulk samples are to be analyzed. This information on distribution of SKNIR single kernel DON levels within samples may be used to evaluate FHB resistance types such as type II/type III resistance.

Therefore, our present research is focused to estimate bulk DON levels of small grain samples based on single kernel DON analysis and to estimate single kernel DON levels in kernels of spikelets along the artificially inoculated wheat spikes. The objective of these studies are to develop methods to screen varieties for FHB resistance types (Type II and Type III resistance) by analyzing and comparing the distribution of single kernel DON levels in spikes or kernel samples from varieties grown under uniform conditions. Such techniques will allow plant breeders to comprehensively evaluate varieties/crosses rapidly and nondestructively for both FHB resistance and for resistant mechanisms operating in the varieties. These technologies may be helpful to enhance the efficiency of wheat breeding programs for the development of FHB resistant varieties by reducing both time and cost of sample screening for FDK and DON levels.

2. List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):**Accomplishment:**

We have developed calibrations for the SKNIR system to evaluate FDK and to estimate single kernel DON levels. During the 2009/2010 we further validated SKNIR scab sorting and DON estimation capacity working with UNL plant breeders by analyzing FHB kernel samples from 2007 and 2008 cropping seasons.

In 2009/2010 the SKNIR sorting technique was used to evaluate FHB resistance in 232 breeding lines from UNL and 108 lines from NDSU. This technique was also used to evaluate kernels from FHB integrated control experiments from UNL and to test the effect of pearl-milling on DON levels in near-isogenic red and white seeded lines from SDSU. These applications of our SKNIR technology shows that it can be used to evaluate breeding lines as well as other treatments tested for reduction of DON in harvested grains or for the control of FHB disease in the field.

Impact:

This technology was used to rapidly and objectively assess FDK and DON levels in single kernels of wheat samples and thereby help improve the efficiency of wheat breeding programs. It was also used to assess other agronomic methods tested/used for reducing FHB disease in wheat crops or for reduction of DON in harvested grains.

Include below a list all germplasm or cultivars released with full or partial support of the USWBSI. List the release notice or publication. Briefly describe the level of FHB resistance.

Not applicable

Include below a list of the publications, presentations, peer-reviewed articles, and non-peer reviewed articles written about your work that resulted from all of the projects included in the grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

Peiris, K. H. S., W. W. Bockus and F. E. Dowell (2010) Nondestructive single kernel DON analysis of wheat for FHB resistance evaluation. Abstract submitted for AACC Meeting 2010.

Peiris, K.H.S., M. O. Pumphrey, Y.Dong and F.E. Dowell (2010) *Fusarium* head blight symptoms and mycotoxin levels in single kernels of infected wheat spikes. Under internal review. To be submitted to Cereal Chemistry.

Peiris, K.H.S. and Dowell, F.E. (2010) Determination of weight and moisture content of single wheat kernels by near infrared spectroscopy. Submitted to Cereal Chemistry.

Peiris, K.H.S., Pumphrey, M.O., Dong, Y., Maghirang, E.B., Berzonsky, W., Dowell, F.E. (2010) Near-infrared spectroscopic method for identification of *Fusarium* damage and DON in single wheat kernels. Submitted to Cereal Chemistry.

Wegulo, S. N., Peiris, K. H. S., Baenziger, P. S., and Dowell, F. E. (2010) Validation of the accuracy of single-kernel near-infrared technology to sort winter wheat kernels based on scab and deoxynivalenol levels. *Phytopathology* 100, (6) (Supplement) S134-135.

Peiris, K. H. S. and F. E. Dowell (2010) Single kernel NIR sorting to enhance quality of wheat breeding lines. Paper presented at CST-SA - ICC International grains symposium. Quality and safety of grain crops and foods. Department of Food Science, University of Pretoria, South Africa, 3-5 February 2010.

Peiris, K.H.S., M. O. Pumphrey and F. E. Dowell (2009) NIR absorbance characteristics of deoxynivalenol and of sound and *Fusarium* damaged wheat kernels. *J Near Infrared Spectroscopy*. 17: 213-221.

Peiris, K. H. S., M.O. Pumphrey, Y. Dong, S. Wegulo, W.Berzonsky, P.S. Baenziger and F.E. Dowell (2009) Progress on development and application of single kernel NIR sorting technology for assessment of FHB resistance in wheat germplasm. In: S. Canty, A. Clark, J. Mundell, E. Walton, D. Ellis and D. Van Sanford (Eds.), *Proceedings of the National Fusarium Head Blight Forum; 2009 Dec 7-9; Orlando, FL*. Lexington, KY: University of Kentucky. pp. 141-142.

S. N. Wegulo, K. H. S. Peiris, P. S. Baenziger, and F. E. Dowell (2009) Assessment of the accuracy of single-kernel near-infrared technology to sort winter wheat kernels based on scab and deoxynivalenol levels. In: S. Canty, A. Clark, J. Mundell, E. Walton, D. Ellis and D. Van Sanford (Eds.), *Proceedings of the National Fusarium Head Blight Forum; 2009 Dec 7-9; Orlando, FL*. Lexington, KY: University of Kentucky. pp. 13-14.

FY09 (approx. May 09 – May 10)

PI: Dowell, Floyd

USDA-ARS Agreement #: NA

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Peiris, K.H.S, M. O. Pumphrey and F.E. Dowell (2009) Single kernel analysis of *Fusarium* head blight symptoms and mycotoxins in infected wheat heads. *Cereal Foods world* 54:A60